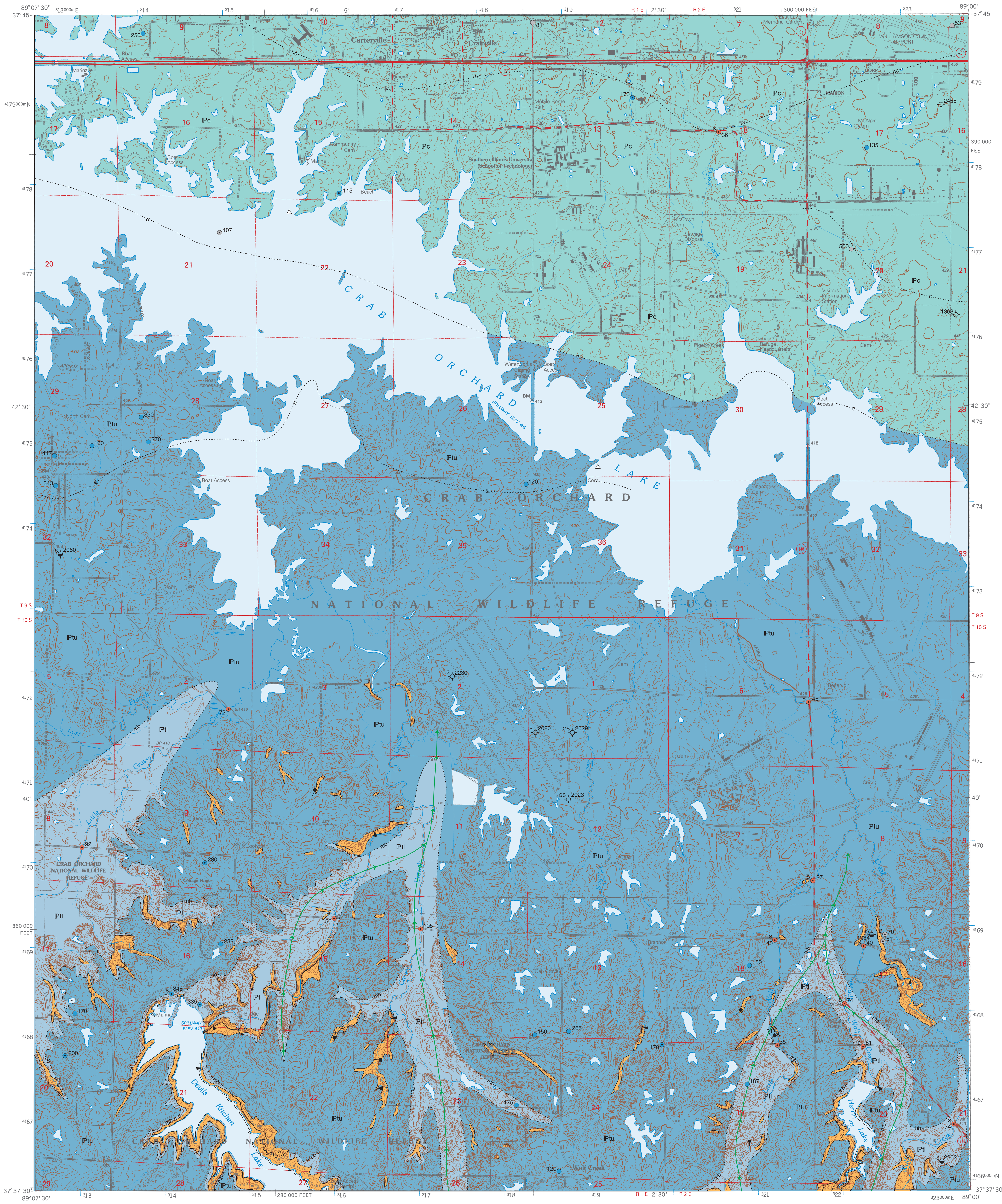
Illinois Department of Natural Resources
ILLINOIS STATE GEOLOGICAL SURVEY
William W. Shilts, Chief

# BEDROCK GEOLOGY OF CRAB ORCHARD LAKE QUADRANGLE

## WILLIAMSON COUNTY, ILLINOIS

Illinois Geologic Quadrangle Map
IGQ Crab Orchard Lake-BG

W. John Nelson
2007




### EXPLANATION

Pennsylvanian

- Desmoinesian
  - Pc — Carbondale
    - hc, Houchin Creek Coal Member
    - c, Colchester Coal Member
    - d, Davis Coal Member
  - Ptu — Tradewater Formation, upper part
    - st, Stonefort Limestone Member
    - mb, top of Murray Bluff Sandstone Member
- Atokan
  - Ptl — Tradewater Formation, lower part

### Symbols

20 — Strike and dip of bedding; number indicates degree of dip

Vertical joint

Outcrop of special note, where unit or contact was well exposed at time of mapping

Bedrock outcrop

△ Bedrock outcrop now under water, from historic field notes

### Drill Holes

from which subsurface data were obtained

Engineering boring

Water well

Coal boring

Dry hole

Dry hole - show of oil

CSG 210 — Numeric label indicates total depth of boring in feet. Boring with samples (S), geophysical log (G), or core (C). Dot indicates location accurate within 100 feet.

### Line Symbols

dashed where inferred, dotted where concealed

Contact or bed subcrop

Preglacial valley, drawn along axis of valley with arrows in direction of stream flow. Only well-defined valleys are mapped.

Note: This subcrop map shows the bedrock surface with all Quaternary deposits removed. Well and boring records are on file at the ISGS Geological Records Unit and are available online from the ISGS Web site.

Base map compiled by Illinois State Geological Survey from digital data provided by the United States Geological Survey. Topography compiled 1963. Planimetry derived from imagery taken 1993. PLSS and survey control current as of 1996. Partial field check 1996.

North American Datum of 1927 (NAD 27)
Projection: Transverse Mercator
10,000-foot ticks: Illinois State Plane Coordinate system, east zone (Transverse Mercator)
1,000-meter ticks: Universal Transverse Mercator grid system, zone 16

**Recommended citation:**
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SCALE 1:24,000

1  1/2  0  1 MILE

1000  0  1000  2000  3000  4000  5000  6000  7000 FEET

1  .5  0  1 KILOMETER

BASE MAP CONTOUR INTERVAL 10 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

Released by the authority of the State of Illinois: 2007

Geology based on field work and data analysis by W.J. Nelson, 2001–2003.

Digital cartography and graphics by T. Goeppinger, M. Jones, L. Verhelst, and M. Widener, Illinois State Geological Survey.



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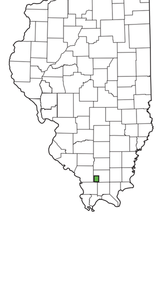


| | | |
|---|---|---|
| 1 | 2 | 3 |
| 4 | | 5 |
| 6 | 7 | 8 |

ADJOINING QUADRANGLES
1 De Soto
2 Herrin
3 Johnston City
4 Carbondale
5 Marion
6 Makanda
7 Lick Creek
8 Goreville


APPROXIMATE MEAN DECLINATION, 2007

ROAD CLASSIFICATION

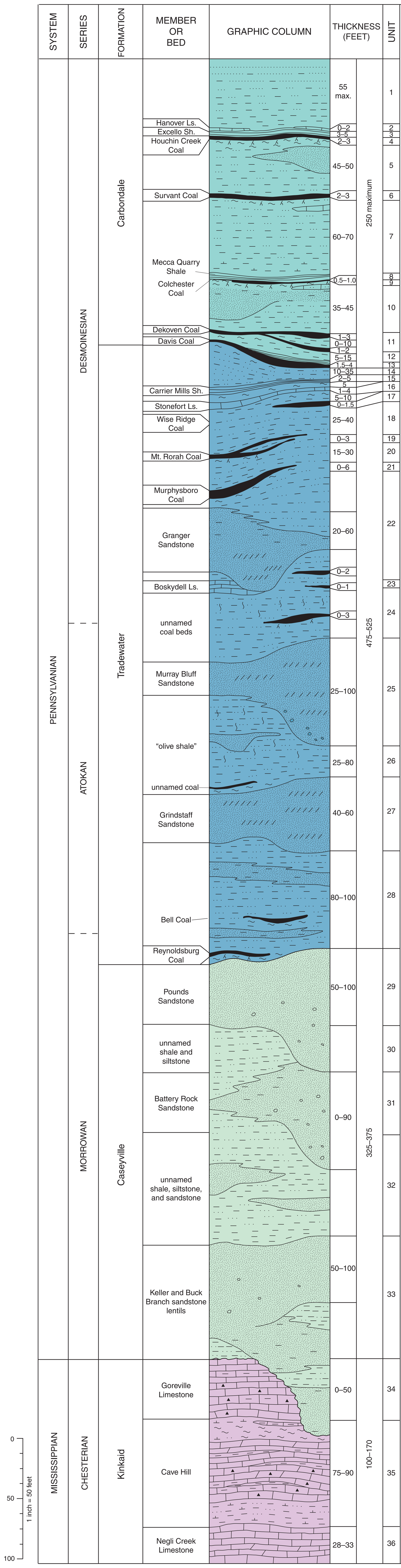
Primary highway, hard surface

Secondary highway, hard surface

Light-duty road, hard or improved surface

Unimproved road

State Route




## Carbondale Formation

**1 Clastic interval** Coarsens upward from gray shale at the base to gray siltstone or fine-grained, shaly sandstone in the upper part.
**2 Hanover Limestone Member** Dark gray, argillaceous, fossiliferous lime mudstone to wackestone.
**3 Excello Shale Member** Black, highly carbonaceous, thinly fissile shale.
**4 Houchin Creek (No. 4) Coal Member** Banded bituminous coal.
**5 Clastic interval**, similar in lithology to Interval 1 above but thinner. Siderite nodules and fossil plants occur in the lower part.
**6 Survant Coal Member** Banded bituminous coal.
**7 Clastic interval** Either coarsening or fining upward. Where the interval coarsens upward, sandstone in the upper part gradually changes downward to siltstone, silty shale, and dark gray clay shale. Where the interval fines upward, it is largely sandstone that has an erosional lower contact, cutting downward nearly to the Colchester Coal.
**8 Mecca Quarry Shale Member** Black, highly carbonaceous, thinly fissile shale.
**9 Colchester Coal Member** Banded bituminous coal.
**10 Clastic interval**, either a massive, rooted gray mudstone (underclay) or a thin limestone directly underlies the Colchester Coal. The remainder of the interval generally consists of shaly sandstone in the upper part and gray siltstone or silty shale in the lower part.
**11 Dekoven Coal Member** Banded bituminous coal. In places the coal is split into two "benches," each 1 to 3 feet thick, separated by as much as 10 feet of clastic strata: rooted claystone (underclay), thin sandstone, and gray siltstone or shale.
**12 Clastic interval** Gray, massive, rooted mudstone (underclay) directly underlies the Dekoven Coal. The remainder of the interval contains varying proportions of gray shale, siltstone, and sandstone. Black, fissile shale directly overlies the Davis Coal in places.
**13 Davis Coal Member** Banded bituminous coal.

## Tradewater Formation

**14 Clastic interval** Gray, massive, rooted mudstone (underclay) directly underlies the Davis Coal. The remainder of the interval includes gray sandstone, siltstone, and shale.
**15 Carrier Mills Shale Member** Black, highly carbonaceous, thinly fissile shale. Below the black shale is green claystone or shale.
**16 Stonefort Limestone Member** Buff to yellowish gray, dolomitic lime mudstone that is argillaceous and contains brachiopods.
**17 Wise Ridge Coal Bed** Thin, discontinuous, shaly coal.
**18 Clastic interval** Includes massive gray mudstone immediately below the Wise Ridge Coal. The remainder of the interval is mostly shale and siltstone; black shale directly overlies the Mt. Rorah Coal.
**19 Mt. Rorah Coal Member** Banded bituminous coal that commonly contains a layer of shale or mudstone up to about 1 foot thick in the lower part.
**20 Clastic interval** Rooted claystone directly underlies the Mt. Rorah. The rest of the interval is mostly gray silty shale and siltstone. Black shale may directly overlie the Murphysboro Coal.
**21 Murphysboro Coal Member** Few details are available. In the adjacent Carbondale Quadrangle, where this seam was extensively mined, the Murphysboro is a bright-banded coal containing lenses and bands of fusain and pyrite and, in places, shale partings more than a foot thick.
**22 Granger Sandstone Member** Light to medium brown and brownish gray, soft and friable, very fine- to coarse-grained but typically fine-grained, lithic arenite that contains abundant mica and interstitial clay. In places the sandstone is thick-bedded to massive and displays faint cross-bedding that dips southeast, south, or southwest along with cut-and-fill structures and slumped bedding. Elsewhere the Granger is thin- to medium-bedded and contains shaly laminae and interbeds. The sandstone grades upward to gray siltstone and silty shale, having the rooted underclay of the Murphysboro Coal at the top. The lower contact is erosional where the unit is thick, but gradational where the unit is thin. The best exposures are along Wolf Creek in the NW¼ SE¼ of Sec. 17, T10S, R2E.
**23 Limestone** Well records in the northwestern part of the map area indicate limestone as thick as 22 feet that probably correlates with the informally named Boskydell marine zone in the adjacent Carbondale Quadrangle (Peppers 1993). No lithologic details are available. In the Carbondale area, the Boskydell is an iron-rich, sandy limestone that grades to a calcareous and heavily burrowed sandstone. These rocks contain a variety of marine invertebrate and trace fossils.
**24 Clastic interval** Shale, siltstone, and thin-bedded sandstone, generally coarsening upward. The sandstone is brown, very fine-grained, micaceous lithic arenite containing numerous shale and siltstone laminae. Siltstone is medium to dark gray, micaceous, carbonaceous, and shows planar and lenticular lamination. Siltstone and sandstone are extensively burrowed; well-preserved trace fossils are common. These include *Eiona* sp., a highly distinctive trace that resembles a string of beads; along with a variety of sinuous, horizontal burrows and feeding traces. Also found are rare casts of fossil plants, including *Sigillaria* sp.(?). Shale in the lower part of the interval is medium to dark gray, locally black, well-laminated clay shale to silty shale that contains laminae of light gray siltstone and sandstone. Planar lamination and cross-lamination are developed; siderite nodules are common. The best outcrops are on the northwest bluff of Caney Creek in the NE¼ SE¼ of Sec. 10, T10S, R1E, and a branch of Caney Creek near the common corner of Secs. 14, 15, 22, and 23 of the same township. Borehole records indicate as many as three coal beds, each 1 to 3 feet thick, may occur within this interval.
**25 Murray Bluff Sandstone** Ledge- and cliff-forming, light gray to buff (weathering dark brown), very fine- to coarse-grained sublitharenite to quartz arenite. This unit is better indurated than younger sandstones and contains less mica and interstitial clay. Small quartz granules are locally present. Iron oxide is prevalent; the sandstone displays prolific Liesegang banding on bluff faces. Near Devil's Kitchen lake, the upper 20 feet of the unit appears massive at a distance, but large-scale cross-bedding and slumped bedding are apparent on close inspection. The middle and lower parts of the Murray Bluff have irregular, thin to thick bedding with occasional thin intervals of shale and siltstone. Wedge-planar and tabular-planar cross-bedding are conspicuous; the foreset beds are unidirectional, dipping south, southwest, and west. Trough, overturned, and slumped cross-bedding types are less common. Current, interference, and ladderback ripple marks are abundant; small load casts, poorly preserved burrows and feeding traces, and casts of fossil logs are less prevalent. Lenses of conglomerate composed of clasts of shale, siltstone, and siderite in a sandstone matrix occur near the base of the member. The lower contact is erosional.

## Subsurface Only

Unit 26 and older occur only in the subsurface. Their descriptions are based on well records and on outcrops south of the Crab Orchard Lake Quadrangle.

**26 "Olive shale member"** Shale, siltstone, thin-bedded sandstone and local coal. These rocks are arranged in either one or two sequences that coarsen upward. Dark gray shale, medium to light gray siltstone, and light gray very fine to fine sandstone are interbedded and interlaminated. Trace fossils are common and locally profuse; they include *Lockeia, Chondrites, Eiona,* and a variety of vertical and horizontal burrows. Stigmarian root casts were observed in sandstone near the middle of the unit and a thin coal bed near the base, both along the large stream in the W½ Sec. 33, T10S, R1E, in the adjacent Lick Creek Quadrangle.
**27 Grindstaff Sandstone Member** White to light gray, very fine- to medium-grained quartz arenite that is case-hardened and has a sugary texture. The sandstone is largely thick-bedded to massive and exhibits slumped bedding. Large-scale planar cross-bedding dips south and southwest. The sandstone forms high, rounded bluffs and, in places, large vertical joints become widened by soil creep to form "streets." Both contacts are sharp; the lower one is probably erosional. The best exposures are a short distance outside the map area at Panther Den (SE¼, Sec. 3, T11S, R1E, Union County) and at Giant City State Park in southeastern Jackson County.
**28 Clastic interval** Shale, siltstone, thin-bedded sandstone, and at least two lenticular coal beds. Shale and siltstone range from medium gray to nearly black and are commonly interlaminated. Sandstone is white to light gray, very fine-grained quartz arenite that is laminated to thinly bedded. Planar and ripple lamination are commonly rhythmic. Load casts, tool marks, and trace fossils are common; *Conostichus* sp. and profuse burrows are found near the base. The Reynoldsburg Coal bed near the base and the Bell Coal bed about 30 feet above the base are indicated by borehole data.

## Caseyville Formation

**29 Pounds Sandstone Member** White to light gray, very fine- to coarse-grained, clean quartz arenite that contains well-rounded granules and small pebbles of white quartz. In outcrops south of the map area, the Pounds is thickly cross-bedded to massive and forms rounded ledges and cliffs. The lower contact is deeply erosive. In one well within the map area, the Pounds and Battery Rock Members form a continuous interval of sandstone 190 feet thick.
**30 Shale and siltstone** Medium to dark gray, laminated, slightly micaceous; some beds carbonaceous and contain plant remains; siderite nodules common.
**31 Battery Rock Sandstone Member** Lithology similar to Pounds Sandstone above. Quartz pebbles as large as 0.5 inch are numerous. The unit is lenticular and in places has an erosional lower contact.
**32 Shale, siltstone, and sandstone** The shale and siltstone are similar to those of Unit 30 above. The sandstone is white to light gray, very fine- to medium-grained quartz arenite in lenticular bodies that range from a few feet to about 30 feet thick.
**33 Keller and Buck Branch sandstone lentils** This unit was mapped by Weibel and Nelson (1993). Sandstone is lithologically similar to Pounds and Battery Rock Members, as indicated by well cuttings. Sandstone 80 to 100 feet thick commonly occurs at the base of the Caseyville. Where the Caseyville fills valleys eroded into the Kinkaid Limestone, sandstone alternates with thinner intervals of shale and siltstone. Information on lithology and geometry of sandstone bodies in the map area is scanty. The base of the Caseyville is a major, regional unconformity (Bristol and Howard 1971).

## Kinkaid Limestone

**34 Goreville Limestone Member** Light to dark brownish gray, fine- to coarse-grained limestone. The upper part is skeletal grainstone to packstone in which echinoderm fragments are common. Darker, finer-grained wackestone and packstone make up the lower Goreville. The lower part also is argillaceous and cherty. Both contacts are sharp.
**35 Cave Hill Member** Divisible into upper shale and mudstone, middle limestone, and lower shale. Greenish gray, silty, laminated shale at the top overlies 10 to 15 feet of mottled and variegated mudstone that is calcareous and has blocky structure. Colors include olive-gray and greenish gray, red, and purple. The middle Cave Hill is limestone with thin interbeds of shale. Much of the limestone is dense lime mudstone and wackestone, described as "sublithographic" on sample logs. Crinoidal or skeletal packstone and grainstone are less prevalent and occur mostly in the lower part of the unit. Chert nodules are numerous; shale interbeds are greenish gray to dark gray. The lower Cave Hill is about 20 feet of shale that is dark olive-gray to greenish gray, silty, and calcareous.
**36 Negli Creek Limestone Member** The upper part includes light gray, coarse-grained, crinoidal packstone and grainstone. The remainder is mostly light gray to brown and micritic ("sublithographic" to very fine grained), dolomitic, and cherty limestone. Both contacts are sharp.

## Introduction

This map depicts the bedrock geology of the Crab Orchard Lake Quadrangle as it would appear were all Quaternary surficial materials removed. Nearly the entire quadrangle is blanketed in Quaternary deposits, including glacial drift, wind-blown silt (loess), and Holocene stream sediment. These materials vary in thickness from a few inches to locally more than 100 feet. In addition, large parts of the map area are submerged by artificial lakes. Bedrock outcrops are confined to the southern half of the quadrangle along streams and deep ravines.

Outcrop study was supplemented by examining all available well records on file at the Illinois State Geological Survey (ISGS). These records consist chiefly of drillers' logs that generally lack accuracy and detail. Several oil test holes have electric logs. Samples are available from several oil test holes and a few water wells. I logged these personally in cases when sample studies made by geologists were not already available. Where possible, water-well locations were verified through conversations with homeowners.

## Preglacial Valleys

The Crab Orchard Lake Quadrangle lies immediately north of the southern limit of continental glaciation in Illinois. Prior to glaciation, streams in the southern part of the map area developed consequent drainage, flowing northward down dip-slopes developed on Pennsylvanian sandstone. These streams joined ancestral Crab Orchard Creek, which followed a west-trending strike valley as does the modern stream (now dammed to create Crab Orchard Lake).

When the Illinoian glaciers retreated, the stream valleys were buried in drift, but the overall topography was little changed, and the headwaters of Wolf, Grassy, and Little Grassy Creeks remained unaffected by glaciation. Hence, these streams, along with Crab Orchard Creek, quickly re-established themselves in courses that differ only slightly from their preglacial ones. They cut their channels downward rapidly, in many cases reaching bedrock beneath the glacial sediments. In places where the creeks downcut across former ridges or divides onto resistant sandstone, they became superimposed and entrenched their meanders. Examples can be seen just below the dam at Devil's Kitchen Lake, at the south end of Herrin Lake, and along Wolf Creek in the SE¼ of Sec. 17, T10S, R2E. Similar features occur in the adjacent Lick Creek Quadrangle to the south (Nelson and Weibel 1996).

Where streams incised new courses into bedrock, their former channels remain buried in glacial drift. Some of these buried channels are evident through surface geology, whereas others are known from drilling. Known buried valleys are indicated on the map by green lines, with arrows indicating direction of flow. The extent of buried valleys in the central and northern part of the quadrangle is unknown because no data are available. The mapped patterns of bedrock formations have been adjusted to conform to known preglacial valleys.

## Geologic Structure

The Crab Orchard Lake Quadrangle is situated near the southern margin of the Illinois Basin. As shown by outcrop and subcrop patterns, Pennsylvanian strata in the map area dip uniformly, slightly east of north. The average rate of dip is approximately 1:75, or less than 1°. No faults or significant folds were detected.

## Economic Geology

**Coal**
No coal mining is on record within the map area. The Murphysboro Coal was extracted in surface mines and small underground operations immediately west of the map border. The last mines, which were surface operations, closed in the late 1970s.

Murphysboro Coal of minable thickness probably occurs within the Crab Orchard Lake Quadrangle. However, there are no outcrops, and drilling records are of such poor quality that resources cannot be assessed, and even the location of the subcrop is in doubt. The Murphysboro crop line projects through the Crab Orchard National Wildlife Refuge where mining is prohibited.

The Davis Coal may reach a thickness of 4 feet, but its subcrop is entirely within the Refuge and largely under Crab Orchard Lake. The younger Survant and Houchin Creek Coals both range from 2 to 3 feet thick, making them marginal prospects for surface mining. The Houchin Creek crop line lies largely outside the Refuge, but extensive residential and industrial development along State Route 13 will probably preclude mining.

**Oil and Gas**
Seven test holes for oil and gas have been drilled within the map area. Three encountered shows of oil, but none achieved commercial production; the holes have been plugged and abandoned. The seven holes were drilled to depths ranging from 1,984 to 2,230 feet in order to test Mississippian formations that yield oil elsewhere in Williamson County.

**Sandstone**
A long-abandoned sandstone quarry is along Wolf Creek in the NW¼ of Sec. 17, T10S, R2E. No record of this operation is available. The stone probably was used locally for foundation and building construction.

## Acknowledgments

I extend gratitude to the numerous landowners who granted me property access and verified the locations of wells. I especially thank the management of the Crab Orchard National Wildlife Refuge for allowing access to restricted areas.

## References

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